

DOUBLE-BANDED VIAL FOR USE WITH LEVEL

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DOUBLE-BANDED VIAL FOR USE WITH LEVEL**FIELD OF THE INVENTION**

This invention is related generally to vials and, more particularly, to vials enclosing a bubble for use in levels.

BACKGROUND OF THE INVENTION

It has long been known to utilize the effect of gravity on fluids having different densities to determine the levelness of elements such as building components, machines, lines, poles, etc. Spirit levels, also called bubble levels, are well known instruments utilizing gravity in this way to set horizontal or vertical surfaces. Such levels include a sealed vial containing a bubble, typically air, floating in a non-freezing liquid, usually mineral spirits. The measured surface is considered horizontal or vertical when the air bubble rests between predetermined graduated marks on the vial.

The accuracy with which a horizontal or vertical plane can be determined is critically dependent on the accuracy at which the bubble is centered between the transverse marks on the vial which, of course, is dependent on the visibility of such lines and the outline of the bubble itself. While the position of the bubble can readily be seen under normal lighting conditions, it becomes difficult to see on a heavily clouded day, or at dusk, or in poorly lighted spaces. That is to say, typical conventional levels can be effectively used only in relatively well-lighted environments and, accordingly can put constraints on the times and places craftsmen such as carpenters and bricklayers are able to work efficiently.

Because it is frequently necessary to measure or set the levelness of a horizontal surface or to set or plumb a vertical surface in less than ideal conditions for

locating the position of the bubble in the vial there have been many attempts to provide a level having a more easily located bubble. For instance, others have provided an illumination device in the level to illuminate the vial to enhance visibility of the bubble. Another attempt to enhance bubble visibility included the use of a floating object 5 within the vial. Still other attempts have utilized complicated electrical or fiber optic sensing of the bubble position.

Each of these prior art attempts have failed to provide a simple and inexpensive, yet successful method of overcoming bubble-locating problems. For example, bubble illumination devices may work well in dark conditions, but they 10 provide little assistance when operating in dimly lit or more well lit areas in which the bubble may blend in with the background when viewing the vial. Floats may increase visibility, but their inclusion in the vial often results in less precise measurements. Levels including electrical and fiber optic sensing means are typically too expensive and too sensitive to be handled easily at work sites and may not provide any 15 enhancement to viewing the bubble in certain conditions.

Therefore, there is a need for an improved vial and level which provide increased visibility of the bubble to aid in the location of the bubble during measurements. Furthermore, there is a need for such an improved vial and level which do not require special handling at work sites and which do not require significant 20 additional costs of manufacturing. In addition, there is a need to provide a vial and level which operate well in a variety of lighting conditions and which provide for easy location of the bubble within the vial.

OBJECTS OF THE INVENTION

It is an object of the invention to provide an improved vial for use in levels which enhances visibility of the bubble therein.

5 Another object of the invention is to provide a level utilizing a vial providing increased visibility of the bubble therein.

Another object of the invention is to provide a method of measuring the levelness of an element including utilizing a vial providing increased visibility of the bubble therein.

10 Another object of the invention is to provide a vial having bands circumscribing the vial's cavity and positioned on opposite sides of the cavity's maximum diameter to enhance visibility of the bubble therein.

Another object of the invention is to provide a vial and level having enhanced bubble visibility which do not require special handling at work sites and which do not 15 require significant additional costs of manufacturing.

Another object of the invention is to provide a vial and level providing for enhanced bubble visibility in conditions when the interface between the bubble and liquid in the vial is otherwise difficult to discern.

20 Still another object of the invention is to provide a level which operates well in a variety of lighting conditions and which provides for easy location of the bubble within the vial.

These and other objects of the invention will be apparent from the following descriptions and from the drawings.

SUMMARY OF THE INVENTION

In at least one embodiment, the invention is a vial for use in a level which provides for enhanced readability. The invention represents a significant advance over 5 the state of the art by providing novel elements, including a pair of bands to increase the visibility of the bubble within the vial.

In one embodiment the vial comprises a body having first and second ends, a midpoint, interior and exterior surfaces, at least one marker ring connected with respect to the body, a cavity, a bubble positioned in the cavity and defined by an 10 interface, and first and second dark-colored bands circumscribing the cavity with the first band positioned between the first end and the midpoint and the second band positioned between the second end and the midpoint. In such a vial, the interface, preferably a gas-liquid interface, reflects the first and second bands to cause the interface to appear dark-colored when viewing the bubble from outside the exterior 15 surface, thereby enhancing visibility of the bubble. As used herein, "dark" or "dark-colored" refer to black and those colors approaching black in hue including, for example, dark grey, dark blue, dark green, dark brown, and the like.

In such an embodiment, the cavity is preferably barrel-shaped, i.e., cross-sections of the cavity increase in diameter, reach a maximum diameter, then decrease in 20 diameter. The maximum diameter is preferably near the midpoint which may or may not be equidistant to the first and second ends. The body is preferably cylindrical.

The bands may be opaque such that light does not pass through them or they may be translucent or tinted such that some light passes through. The bands may be positioned on the exterior surface of the body, on the interior surface of the body, or 25 between the interior and exterior surfaces of the body. Alternatively, the bands may be integral with the body and, in such cases, may be comprised of opaque or translucent portions of the body. In certain embodiments, the bands are wider than the bubble.

The vial may further include first and second end closures. In preferred 30 embodiments, the end closures are integral with the body and include portions of the interior surface which defines the cavity. In certain embodiments, such end closures

may be dark-colored and may provide further reflection to the interface in addition to that of the bands.

The at least one marker ring is preferably visible from outside the exterior surface of the vial. The vial preferably includes first and second marker rings which are equidistant to the maximum diameter to allow a user to determine when a bubble is positioned at the maximum diameter. The first ring is preferably positioned between the maximum diameter and the first end and the second ring is preferably positioned between the maximum diameter and the second end. Such rings may be positioned on the exterior surface or on the interior surface, though it is preferred that the rings be positioned between the interior and exterior surfaces.

The invention may also be described as a level for improved measurement. Such a level comprises a measuring surface for contacting an element to be measured, a recess formed in the level at an angular relationship to the measuring surface, and a vial received in the recess. The vial preferably comprises a body having first and second ends, a midpoint, and interior and exterior surfaces, at least one marker ring connected with respect to the body, the at least one marker ring visible from outside the exterior surface, a bubble positioned in the cavity and defined by an interface, and first and second dark-colored bands circumscribing the cavity with the first band positioned between the first end and the midpoint and the second band positioned between the second end and the midpoint. Measurement of the element is facilitated by reflection of the first and second bands on the interface such that the interface appears dark-colored when viewing the bubble. The interface is preferably a gas-liquid interface, though it is believed that it may be the interface between two immiscible fluids.

The interior surface defines a cavity which preferably has a maximum diameter near the midpoint. The bubble rests at the maximum diameter when the vial is oriented perpendicular to the force of gravity. In certain embodiments, the vial includes first and second marker rings equidistant to the maximum diameter, the first ring positioned between the maximum diameter and the first end and the second ring positioned between the maximum diameter and the second end. Such rings may be positioned on

the interior surface or exterior surface though it is most preferable that they be positioned between the interior and exterior surfaces.

In a highly preferred embodiment, the maximum diameter is positioned at the midpoint, the first and second marker rings are positioned equidistant to the maximum diameter, and the bands are positioned equidistant to the maximum diameter. In such an embodiment, the reflection of the bands on the interface of the bubble is even, i.e., because the vial is symmetrical, the reflection of the first band on the interface is the same as the reflection of the second band on the interface when viewing the bubble from a position in the plane perpendicular to the vial and including the maximum diameter.

As stated above in reference to another embodiment of the invention, the bands may be opaque such that light does not pass through them or they may be translucent or tinted such that some light passes through. The bands may be positioned on the exterior surface of the body, on the interior surface of the body, or between the interior and exterior surfaces of the body. Alternatively, the bands may be integral with the body and, in such cases, may be comprised of opaque or translucent portions of the body.

The invention also includes a method of measuring the levelness of an element. The method comprises providing a level having a measuring surface and a vial positioned at a predetermined angular relationship thereto, positioning the measuring surface on the element, and assessing the levelness of the element by locating the position of the bubble.

Such a method is facilitated by using a vial comprising a body having first and second ends, a midpoint, and interior and exterior surfaces, the interior surface defining a cavity; at least one marker ring connected with respect to the body, the at least one marker ring visible from outside the exterior surface; a bubble positioned in the cavity, the bubble defined by a gas-liquid interface; and first and second dark-colored bands circumscribing the cavity, the first band positioned between the first end and the midpoint and the second band positioned between the second end and the midpoint.

When using such a vial in the above method, the bands facilitate locating the bubble by reflecting off of the interface to increase visibility of the bubble. Such a

method may be further enhanced by using bands which are symmetrical about the maximum diameter of the cavity. As discussed above, such bands may be opaque such that light does not pass through them or they may be translucent or tinted such that some light passes through. The bands may be positioned on the exterior surface of the 5 body, on the interior surface of the body, or between the interior and exterior surfaces of the body. Alternatively, the bands may be integral with the body and, in such cases, may be comprised of opaque or translucent portions of the body.

BRIEF DESCRIPTION OF THE DRAWINGS

10 FIGURE 1 is an overhead view of the vial containing a bubble in accordance with the principles of an embodiment of the present invention.

FIGURE 2 is an overhead view of the vial in accordance with the principles of an embodiment of the present invention.

15 FIGURE 3 is a side view of a level in accordance with the principles of an embodiment of the present invention.

FIGURE 4 is a cross section view of the vial taken along line 4-4 of FIGURE 2 in accordance with the principles of an embodiment of the present invention.

FIGURE 5 is a cross section view of the vial taken along line 4-4 of FIGURE 2 in accordance with the principles of an embodiment of the present invention.

20 FIGURE 6 is a cross section view of the vial taken along line 4-4 of FIGURE 2 in accordance with the principles of an embodiment of the present invention.

FIGURE 7 is a cross section view of the vial taken along line 4-4 of FIGURE 2 in accordance with the principles of an embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

FIGURES 1 and 2 are overhead views of an embodiment of the vial 10. Vial 10 includes a body 20 having a first end 21 and second end 22 with a midpoint 23 therebetween. Vial 10 is preferably a plastic material such as acrylic, polycarbonate, polystyrene, butyrates or the like, and is transparent. The internal surface of body 20 defines a barrel-shaped cavity 30 such that there exists a cross-section of the cavity 30 which has a maximum diameter. The maximum diameter 31 is preferably positioned near or at the midpoint 23.

Vial 10 further includes at least one marker ring 40 connected with respect to the body 20, shown as a first marker ring 41 and a second marker ring 42. The marker rings 41,42 are preferably equidistant to the maximum diameter 31. As shown, a bubble 50 is positioned within the cavity 30 at the maximum diameter 31 and between marker rings 41,42. The bubble 50 is defined by a gas-liquid interface 51 with the bubble being gas 52 and the rest of the cavity 30 being filled with liquid 53. The gas 52 is preferably air and the liquid 53 is preferably mineral spirits or the like.

Vial 10 also includes dark-colored bands 60 circumscribing the cavity 30. First band 61 is positioned between maximum diameter 31 and first end 21 and second band 62 is positioned between maximum diameter 31 and second end 22.

Vial 10 further includes end closures 70 at the first and second ends 21,22. First end closure 71 is at first end 21 and second end closure 72 is at second end 22. First and second end closures 71,72 are preferably integral with body 20 and enclose cavity 30.

FIGURE 1 shows bubble 50 positioned at the maximum diameter 31. Viewing line 52 shows the how the first band 61 is reflected off of interface 51 when viewing the vial 10 from the side. As is apparent, innumerable reflections of the bands 60 off of interface 51 provide the viewer with a dark-colored outline of the bubble 50 along its perimeter. The interface 51 between the viewer and the bubble 50, i.e., the central portion of the bubble 50 in FIGURE 1, appears to not reflect the bands. In a preferred embodiment, bands 60 are about $\frac{1}{2}$ inch wide and are equidistant to the bubble 50 when positioned at the maximum diameter 31. Each bands 60 may be about $\frac{1}{2}$ inch from the maximum diameter 31.

FIGURE 3 is a side view of a level 80 including vial 10. Level 80 includes a measuring surface 81 for contacting an element (such as a building surface) to be measured. A recess 82 is formed in the level at an angular relationship to the measuring surface 81. Recess 82 receives and holds vial 10 at an angular relationship to the measuring surface 81. As shown, vial 10 is parallel to measuring surface 81.

FIGURE 5 shows a cross section view of the vial 10 taken along line 4-4 of FIGURE 2 in which first band 61 has been applied to the exterior surface 25 of vial 10. FIGURES 4, 6, and 7 are alternate cross section views of the vial 10 taken along line 4-4 of FIGURE 2. In FIGURE 4, first band 61 is shown on the interior surface 24 of vial 10. In FIGURE 6, first band 61 is shown in body 20 between the interior and exterior surfaces 24,25. Such an embodiment may include a dual component overmolded vial 10 in which the bands 60 are positioned on an inner cylinder before an outer sleeve is molding around the cylinder and sleeve. In each of these embodiments shown in FIGURES 4-6, bands 60 may be a foil comprised of metal, thermoset material, thermoplastic material having a high melting point, ink, pigment or other dark material, and bands 60 may be hot stamped, pressed or rolled into, printed onto or otherwise applied to body 20. In FIGURE 7, first band 61 is integral with body 20 and can be said to be positioned between the interior and exterior surfaces 24,25 of body 20. In such an embodiment, bands 60 may be comprised of opaque or translucent portions of the body.

Thus, it should be apparent that there has been provided, in accordance with the present invention, a vial for use with levels that fully satisfies the objectives and advantages set forth above.

Although the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and broad scope of the appended claims.